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ABSTRACT

Problem solving has been studied extensively for tens of years and is based on a set of generic steps. A content theme is needed for these generic skills to be used and theme-based learning was chosen to be the medium for the project Key Learning Community (KLC). This paper describes the implementation of the problem solving approach into the KLC using theme-based education in one K-12 magnet school in the Indianapolis Public School system. (Contains 61 references.) (YDS)

Integrating Problem Solving with Theme- based Learning in "The Key Learning Community"

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Integrating Problem Solving with Theme- based Learning in "The Key Learning Community"

Introduction

The idea of schools doing more than just presenting information has a long history. Burnap (1822) saw broader educational reasons for science books when he criticizes those, "Unmindful of the primary objective of education, which is *mental discipline.*" He goes on to say, "Many have been unwilling to afford their children time and opportunity, for acquiring any more scientinfick knowledge, than barely to qualify them for the business, which they designed to pursue. (Spelling and italics in original.) Hooker (1858) goes even further when in the preface to his book he says, "The chief defect in primary instruction, as it is commonly pursued, *is the failure to teach children to think.* Everything is learned almost entirely by rote. "

So even the move towards a knowledge-based society in the USA, which has been credited with shifting our focus over the last twenty years, has historical precedent. However, we have to have a starting point and we will use the 1983 report, "A Nation at Risk," by The National Commission on Excellence in Education, produced during President Reagan's first term in office. It had startling conclusions in terms of mediocrity in U.S. education in general with possible dire consequence for the nation and its people. The Secretary's Commission on Achieving Necessary Skills (SCANS) listed a number of core competencies and skills among which "thinking skills" was of primary significance (O'Neil, 1991). The thinking skills area comprised in essence critical thinking, decision-making, and problem solving components.

These reports and undertakings were followed first by President George Bush's and then by President Clinton's leadership in the establishment of national goals for education. In 1994 Congress passed the Goals 2000 Educate America Act, which was signed by President Clinton. In line with a society increasingly information-based and reliant on technology, critical thinking and problem solving were recognized as core skills to be emphasized in formulation of educational policy.

Despite this overarching focus on critical thinking and problem solving, it would be difficult to say that significant inroads have been made in teaching these as foundation skills in any wide spread manner in K- 12 education in the U.S. We believe this is basically due to a few critical issues.

- The amount of work done in the area of problem solving since Dewey's time (1910) by different researchers has not been developed in a framework that can be easily understood and implemented by K-12 teachers.
- Lack of a good model for integration of problem-solving skills teaching with other teaching techniques that have found acceptance in K-12 education such as the "theme-based learning."
- An emphasis on curriculum that will foster improved scores on standardized tests in reading and mathematics.

This paper/presentation aims to both provide a structural framework for problem solving as part of problem solving emphasis in education, as well as, describe a technique for combining problem-solving skills teaching with theme-based learning. This is being successfully used in K-12 education in one particular school in Indianapolis and could serve as a model for implementation at other locations throughout the country.

A Framework for the Problem-solving Process

The area of problem solving has probably been the subject of extensive thought for hundreds of years. We will start our look at problem solving frameworks with Dewey's work from 1910. As one part of the bigger area of critical-thinking and decision-making, problem solving has been studied extensively in terms of problem definitions, problems types, and steps of problem solving.

Despite the length of time over which such work has taken place and the number of contribution to the field, such work has, in most cases, has only marginally advanced the pursuit of problem solving in school settings. This is because several researchers, mostly working alone and not necessarily building on the work of others, have stated the same basic theory and understanding with slight differences in wording,(See Table 1 after Figure 1). Thus the area of the problem solving is not as complex as it is perceived. But it is possible this perception of complexity has hindered its wide spread acceptance and implementation in K-12 education.

As been done by Jonessen (2001) for "the types of problem-solving" for exhibiting problem-solving being applied to different kind of problem definitions in diverse contexts, the table below, formulated by the authors, aims to bring the same kind of structure and order to the area of "problem solving steps." As should be clear from this layout, the work that flourished under the leadership of Dewey has been advanced by others, but not to a degree to be become too complex to implement in K-12 settings. Actually the second part of this paper describes a methodology by means of which such use is implemented in selected schools.

Integrating Problem Solving Skills Development with Theme-based Education

Problem- solving is often presented as a methodology based on a set of generic steps that can be applied to a broad range of problems for generation of solutions. Jonessen has studied the area of the different kinds of problems that can be handled by the general approach of problem solving. It is obvious that for a generic skill to be of any use, there needs to be a content theme within which it can based. Thus, it is no surprise that " Theme-based Learning" was chosen as the medium through which problem solving could make inroads into K-12 education. The "Key Learning Community" described below details the approach that was implemented to couple problem solving with theme-based education.

Problem Solving in a School Setting: The Key Learning Community

There are likely many ways to implement problem solving ideas into the school curriculum. One example that we will share has been developing since 1987 when the Key Learning Community (KLC) began as a P-6 magnet school within the Indianapolis Public School system. It is currently a K-12 magnet and in 2003 will have its first class of graduates from the K-12 program.

History of the Key Learning Community: The ideas behind the KLC began when teachers of art, music, and physical education tried to integrate their subjects into the mainstream of an elementary school. Early in the process they contacted Howard Gardner and obtained significant help in their planning process. They felt his then "new" (1982) Theory of Multiple Intelligences (MI) had implications for their concerns. This was the first attempt to implement MI into a school setting. Gardner was very helpful, providing ideas, connections to other educational researchers, and most importantly personal interactions with the public school teachers. He also attended school board meetings in Indianapolis, spoke to concerned groups about the ideas being proposed, and reviewed the teachers' proposals.

The overall theoretical framework of the KLC is shown in Figure 1. What is most interesting about this framework is the integration of several theories and practical activities around the idea of Theme-based Integrated Curriculum (Macdonald, 1971). While the KLC was the first school to use Multiple Intelligences in its design, its philosophical and psychological frameworks are not limited to MI. The KLC works because it integrates MI with several complementary theories. As the principal has told us, it is easy for a researcher or university faculty member to concentrate on one theory. Practitioners, however, have to be able to integrate several complementary theories. So while Multiple Intelligences provides an anchor, the school also values Boyer's *Human Commonalities*, Feldman's *Developmental Continuum*, Csikszentmahalyi's *Flow Theory* (Intrinsic Motivation), and the ideas of *Quality Work* as proposed by Deming, Glasser, and Senge (Boyer, 1982, 1995; Csikszentmahalyi, 1985, 1990; Feldman, 1980, 1994; Senge, 1990, 2000). In the center of the framework in Figure 1, is "Theme-based Integrated Curriculum". This presentation

will describe how we believe the Theme-based Integrated Curriculum serves as a powerful approach to integrate problem solving into the school curriculum.

History of the relationship between the Key Learning Community and the School of Education at IUPUI: The relationship between the Key Learning Community (KLC) and the Indiana University School of Education at IUPUI (SOE) began when the "Key School" was still in the planning stage. Two faculty members from the SOE were asked to be mentors to individual teachers who were part of the original planning faculty of the Key School. The future Key School teachers presented their plans to a meeting of the SOE looking for additional support. Faculty from the SOE attended and presented supportive testimony at several meetings of the Board of School Commissioners of the Indianapolis Public School. Over the years university faculty have served on various KLC Committees and continued to support the school at School Board meetings. At the same time KLC faculty have cooperated with the SOE in various planning activities, taught courses for the SOE, and worked on projects with individual SOE faculty. It has been a partnership of equals in which both groups have benefited.

From the first semester the Key Learning Community opened, students from IUPUI teacher education classes have participated in field experiences at the School. For the first few years, only students in the elementary school science methods class participated in field experiences. These students were at the Key School about 20 hours a semester. Eventually students in the elementary school mathematics methods course were scheduled with the science methods students. Their integrated field experience requirement of 40 hours meant that the IUPUI students were at the KLC for ten mornings a semester. Since the fall of 2000 students in fours or five *blocked* IUPUI teacher education classes participate in a coordinated field experience of between ten and fourteen full days at the KLC. Several of the students from the fall of 2000 continued their field experiences during the spring of 2001 and one of these students completed her student teachers at KLC in the spring of 2002. The students who began their field experience in the fall of 2001 remained at KLC for three semesters of field experiences and four are currently student teaching during the spring 2003 semester.

The cooperative nature of this relationship cannot be overstated. Neither can the benefits to both groups. The IUPUI School of Education gains prestige through its association with such a well-respected school. The Key Learning Community's activities are enhanced by the professional support from the university. But it is more than both being in the reflected glow of the other. Each helps the other move along Feldman's Developmental spectrum (see fourth column in Figure 1). And as a result we may possibly create Unique or Idiosyncratic concepts that can be used to further develop the Discipline Based developmental pattern in Teacher Education.

Feldman's Developmental Continuum: We learned about Feldman's work through our interaction with the KLC. One day we were carrying out Piaget's conservation interviews and the principal said, "Oh! Feldman says Piaget is at the Universal level." What a let down to learn that one of the frameworks we were teaching at the university was only a small part of the development of a teacher and any other professional or specialist. In brief, the Universal level is development that would be expected of any human regardless of culture. It therefore makes sense to place Piaget in this level. At the Cultural level development is controlled by the culture of the individual. One reason we believe our students have problems implementing ideas learned at the university is that these concepts do not fit the American cultural view of schooling and learning. (We could spend more time on this but will leave it for another discussion.) Within Discipline-based development a Novice would have a beginning awareness of the subject area. An Apprentice could follow steps in a process provided it is similar to previous experiences. A Journeyman is able to go beyond following the proscribed procedures and adapt practice to the context. The next three levels are driven by direct practice and therefore probably no appropriate for elementary and secondary school students, and many pre-service teachers. (Feldman, 1980; Kim, 1998)

Problem Solving as the Culture of a School: School curricula may include problem solving as a goal. Often this is expressed by attempts to integrate problem solving into all classes. Other schools may have a special problem solving class or program. At the Key Learning Community the categories found in the models of problem solving included earlier in this paper are integrated into the fabric of the school as a major component of its curriculum. This occurs through in a number of ways, but is easiest to describe as part of the Theme Based Integrated Curriculum.

Throughout their program at the KLC, children, from Kindergarten on, are required to present a project on the current theme. The projects are presented to the entire class and are videotaped. These tapes are collected over time and a child who stays at the school from Kindergarten to 12th grade will have a set of tapes covering the presentations over time. Teachers continually review the tapes in an attempt to find exemplars of children's work in all intelligences and at Feldman's Novice, Apprentice and Craftsman levels. These examples are used to continually improve the assessment system and rework the curriculum.

Themes: The themes used at the KLC are different from that at most schools. Since 1987 only two themes have been repeated. Teachers felt that even though several years had passed since the theme was used, many of the ideas from the initial use of the theme limited creativity and freshness when the theme was repeated.

The themes are also very broad and open to several interpretations. Examples of the themes are Blueprints, Illusions, Keepers of the Earth, Pathfinders, Tapestries, Tools, and Communities. When Blueprints was the theme we observed a class discussing the theme and listing examples of blueprints on the board. These included shopping lists and stereotyping as types of blueprints. It is interesting that we are impressed with this type of discussion as it expands children's views of language and may help younger children questions their literal approach to vocabulary.

We will describe a few examples of the presentations from the theme Illusions to provide an idea of what children present. We will then show how these presentations implement the models of problem solving presented earlier. A Kindergarten child said he always wanted to get inside a book and with the help of his parents took a large box and made it into a book with a cover that would open. Along one side were lines representing the pages of the book. Inside he had a large diagram/picture with plastic flowers and drawings. Describing the contents, he showed the green plants and called them, "Greenery." He then showed the pink flowers and called them the, "Pinkery."

A third grader, with a twinkle in his eye first showed a jacket and asked what it has to do with Illusions. After the children guessed, he said it had no relationship but was covering something and asked the children to guess what was covered. When they guessed food, he said they were correct and handed out cookies which the children began to eat. He then read the recipe, which he found on the Internet, and in addition to flour and sugar it included a half cup of chopped insects. He then discussed how people all over the world eat insects. Finally, he got to the illusion and said you could substitute chopped nuts for the insects.

There were several optical illusion presentations and a child who produced a video of various illusions in art including a local artist who painted outdoor scenes on buildings to make the building appear to be something else. One fifth grader did a project on the illusion you will win the lottery. He kept a record of how much he spent each week and what he won or did not win. He then presented data from the lottery about where the money came from and how it was spent. To conclude his project he gave the teacher an unscratched ticket to see if she would win. The teacher asked the children if she would win before she said, she did not think so from the presentation. And of course the student was correct. It is an illusion you will win.

We believe these projects, a major part of the curriculum, are examples of implementing the problem solving skills described over the last 100 years. The children select the topic, plan their presentation, collect data, put their project together, present the project, and review their

presentation with other students and teachers. The methods used by the KLC students include most of the critical parts of a problem solving models discussed above. And while it is important to be aware of these models, implementation within a school setting may require an entirely different model. One that is based on a different set of values for the school. A culture that fosters children's intrinsic motivation and a curriculum that encourages children to find learning interesting and relevant to their everyday life in and out of school.

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Key Learning Community - Theory to Reality

Multiple Intelligences:
Howard Gardner

- Linguistic
- Musical
- Logical / Mathematical
- Naturalist
- Spatial
- Bodily / Kinesthetic
- Interpersonal
- Intrapersonal

Curriculum and Instruction:
- Flexible Scheduling
- Integrated Curriculum
- Teamwork and Collaboration
- Authentic Pedagogy
- Culminating Activity

Intrinsic Motivation:
M. Csikszentmahalyi

- Clear Goals
- Challenges relatively matched with skill level
- Immediate Feedback
- Concentration without fear of being interrupted
- No external time constraints

Collaborative Environment:
- Multi-age, Multi-ability groups
- Projects developed in high interest area
- Choices offered for "Pod" class
- Flow Activity Room
- Opportunities for students and staff to focus on strengths

Human Commonalities:
Ernest Boyer

- Shared Life Cycle
- Shared Use of Symbols
- Shared Membership in Groups and Institutions
- Shared sense of Producing and Consuming
- Shared Relationship with Nature
- Shared Sense of Time and Space
- Shared Values and Beliefs
- Shared Sense of the Aesthetics

Theme-based Integrated Curriculum (James Mcdonald) Organizing Center

Human Commonalities:
- School Compact
- Weekly Program Related to Theme
- Mentor Program
- Opportunities for Service
- Exit-level Performance Criteria - High School
- Multi-media Portfolios

Developmental Continuum:
David H Feldman

- Universal
- Cultural
- Discipline-based
  1. Novice
  2. Apprentice
  3. Journeyman
  4. Craftsman
  5. Expert
  6. Master
- Idiosyncratic
- Unique

Authentic Assessment:
- Projects
- Video Portfolios of Projects
- Developmental Performance Descriptors
- Quality Exemplars
- Assessment in each area of Intelligence

Learning Organization:
Peter Senge

- Personal Mastery
- Mental Model
- Shared Vision
- Team Learning
- Systems Thinking

Continuous Improvement:
- "Critical Friends" Collaborative Peers
- Professional Development
- Teacher Portfolios
- Academic Achievement Plan, P.L. #221
- North Central Accreditation

Figure 1 Overall Theoretical Framework for the Key Learning Community

PROBLEM SOLVING STEPS ACCORDING TO DIFFERENT RESEARCHERS

KOHLER (1927)

Identifying problem
Incubation period
Insight
Memory of insight
Generalization of solution

DEWEY(1910)
A felt difficulty
Its location and definition
Suggestion of possible solution
Development by reasoning of the bearings of the suggestion
Further observation and experiment leading to its acceptance or rejection

GREENO (1978)

The processes of the constructing a problem representation
Searching for solution and
Implementing
Monitoring solution

POLYA (1945)

To understand the problem to note the existing data and constraints and see what is needed to solve the problem
To formulate plan
To carry out plan and check it by confirmation of each relevant test at each stage
Even after solution is reached we should check through the method to help our own experience and insight(Heuristics) and possibly improve the method of achieving the solution

BINGHAM (1958)

Familiarity with (Recognize)the need for solving the problem
Explanation of the problem familiarity with its quality its field attempts to comprehend the other related problems
Collection of the information
Selection of the proper data and arrangement of them
Identification of the possible solutions
Evaluation of types of solutions and
Selection the best one among the alternatives
Implementation of the best solution
Evaluation of the method employed

HANEY & SARENSON (1977)

Sense and definition of the problem
Form hypothesis or tentative solution
Predict the consequences of the hypotheses and chose the most possible one
Design and carry out investigation to test the hypothesis.
Gather data, interpret data, and evaluate data to determine whether or not it supports the hypothesis.
Communicate the result of the investigation
Others repeat and verify

BRANSFORD & STEIN (1984)

Identifying potential problem
Defining and representing the problem
Exploring possible strategies
Acting on those strategies
Looking back
and
Evaluation the effects of those activities

ISAKSEN & TREFFINGER (1986)

Mess finding
Data finding
Problem finding
Idea finding
Solution finding
Acceptance finding

HAYES (1989)

Finding the problem
Representing the problem
Planning the solution
Carrying out the plan
Evaluating the solution
Consolidating gains

MOYLES (1989)

Statement of the problem and its clear definition
Using brainstorming technique for the problem
Possible solutions for the problem
Evaluation of the selected solution by applying to the problem
Evaluation of the result

SOUVINEY (1989)

Understanding of the problem
Step of the determination of the strategy relate to the solution of the problem
Going to be used for the solution of the problem
Determination of the strategy related to the solution of the problem
Application of the selected strategy
Evaluation of the final solution

WEST & IDOL91990)

Determining a goal or subject
Defining the problem with different approach
Making a brainstorming session
Choosing strategies
Application of selected strategy
Forecasting the future of the problem
Performance evaluation
Correction

BART (1994)

Experience
Variance and uncertainty
Identification of the problem
Develop a testing mechanism
Research and proof
Generalization

HICK (1994)

Problem
Data collection
Redefinition
Development of the proper solution
Selection of the best solution
Approval of the solution and implementation

SORENSON & OTHERS (1996)

Working backwards
Simplifying and reducing
Recognizing patterns
Organizing list
Guessing and
Testing
Forming analogies
Making a drawing or figure
Making a table or graph
Acting it out

SORENSON & OTHERS (1996)

Clarify
Explore the problem
State the problem
Forecast
Generate optional solutions
Select the best solution
Investigate
Generate optional designs
Select and implement best design
Evaluate
Organize and interpret result
Judge result
No start over review,revise
Yes communicate the result

EGGEN & KUCHAK (1997)

Present problems in meaningful contexts
Present of variety of examples
Discuss problems in detail
Provide practice in defining for beginning problem solvers
Visually represented problems
Teach general problems solving strategies

BEDEYORE (1997)

Listening
Researching
Determining a goal
Supporting
Monitoring

BRITS (1997)

Instruction of the problem
Brain storming to find the possible solution
Testing the selected solution
by its application on the problem
Evaluation of the result

KNEELAND (1999)

Understanding the problem
Gathering good information
Getting to the root of the problem
Raising the options
Choosing the best solution
Getting it solved

MCALISTER (2000)

Knowledge
Rules and regulations
Application

ARENOFSKY (2001)

Acknowledgement of the problem
Identification of limits and conditions
Creation of the proper strategy to solve the problem
Collection of data
Monitoring problem solving as a whole
and evaluation of the solution

BOGOYOGO & KELLY & SALEM (2002)

Knowledge base
Skill base
Source base
Strategically source base
Behavioral base

IUPUI - US & GU-TURKEY
SCHOOL OF EDUCATION

DR. MICHAEL R. COHEN & DR.NURDAN KALAYCI

Table 1.Exaple of the problem solving modcls reviewed in this paper

SE047210

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